Paper No. 39

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte RAVI IYER

Appeal No. 2000-1702
Application No. 08/841,908

ON BRIEF

Before GARRIS, LIEBERMAN, and KRATZ, Administrative Patent Judges.

LIEBERMAN, Administrative Patent Judge.

DECISION ON APPEAL

This is an appeal under 35 U.S.C. § 134 from the decision of the examiner refusing to allow claims 2, 4 through 7, 9, 10 18, 20 through 23, 25 and 26. Claims 3, 11 through 16, 19, 27 through 32 and 40 through 46 stand withdrawn from consideration.

THE INVENTION

The invention is directed to a method for depositing silicate glass on a semiconductor wafer wherein carbon particles impurities on the upper surface of the wafer is subjected to a plasma ignited in a gaseous atmosphere containing a mixture of a diatomic oxygen and an oxygen containing oxidant. The plasma converts the carbon particle impurities to a carbon containing gas which can be removed from the chamber. Additional limitations are described in the following illustrative claim.

THE CLAIM

Claims 2 is illustrative of appellant's invention and is reproduced below.

2. A method for depositing silicate glass on a semiconductor wafer comprising the steps of:

placing the wafer within a chemical vapor deposition chamber equipped with a plasma generator;

flowing a gaseous mixture comprising TEOS and diatomic oxygen into the deposition chamber while generating a plasma in the chamber, thereby depositing a silicate glass base layer having an upper surface on the wafer, said glass base layer having carbon particle impurities on said upper surface;

subjecting the base layer to a plasma ignited in a gaseous atmosphere containing a mixture of diatomic oxygen and a diamagnetic, oxygen-containing oxidant, for a period sufficient to convert said carbon particle impurities to a carbon-containing gas which can be removed from the chamber; and

depositing a final glass layer on said upper surface by flowing TEOS gas and ozone gas into the chamber.

THE REFERENCES OF RECORD

As evidence of obviousness, the examiner relies upon the following references:

Hochberg et al. (Hochberg)	4,992,306	Feb. 12, 1991
Nguyen et al. (Nguyen)	5,356,722	Oct. 18, 1994

THE REJECTION

Claims 2, 4 through 7, 9, 10 18, 20 through 23, 25 and 26 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Nguyen in view of Hochberg.

OPINION

We have carefully considered all of the arguments advanced by the appellant and the examiner and agree with the appellants that the rejection of each of the claims are not well founded. Accordingly, we reverse this rejection.

The Rejection Under § 103(a)

"[T]he examiner bears the initial burden, on review of the prior art or on any other ground, of presenting a *prima facie* case of unpatentability." See In re Oetiker, 977 F.2d 1443, 1445, 24 USPQ2d 1443, 1444 (Fed. Cir. 1992).

It is the examiner's position that, "given the disclosure in Hochberg et al. That glass films deposited from TEOS and oxygen under plasma conditions at about 350°C are not pure silicon dioxide and contain carbonaceous impurities and that it is conventional in the

art to treat such plasma deposited TEOS silicon oxide films with an ozone and oxygen plasma to remove these carbonaceous impurities (col. 12, liner 55 to col. 13, line 3), it would have been obvious to treat the plasma deposited TEOS silicon oxide film of Nguyen et al. Prior to depositing the further layers to remove said carbon impurities from said film." See Answer page 3. We disagree.

Nguyen is directed to an improved method of depositing silicon oxide. See column 1, lines 6-7. In particular, we find the invention is directed to a method of depositing silicon oxide layers by thermal decomposition of tetraethoxysilane (TEOS) and ozone. See column 1, lines 8-10. Nguyen discusses the reasons for surface sensitivity when silicon oxide films are deposited on silicon oxide. See column 2, lines 29-30. Nguyen states that this sensitivity is believed to be due to the presence of Si-OH species on hydrophilic surfaces. See column 2, lines 31-32. Inasmuch as TEOS molecules are hydrophobic they do not adhere well to the underlying hydrophilic surface and are repelled by such hydrophilic surfaces. See column 2, lines 33-35. Nguyen solves this problem by substituting nitrogen atoms in the first layer of deposited TEOS silicon oxide film which prevents hydrogen bonding to the surface of water or -OH radicals. See column 2, lines 43-47. Stated otherwise, the first layer deposited is rendered hydrophobic. Thereafter a second layer of silicon oxide is deposited over the nitrogen containing silicon oxide under

layer by known CVD (chemical vapor deposition) TEOS/ozone/oxygen process. See column 2, lines 62-64.

In Example 1, the sole example present in Nguyen, the first nitrogen containing silicon oxide layers deposited were deposited under conditions using a PECVD reactor (plasma enhances chemical vapor deposition) at 350° - 450 °C. See column 4, lines 33-48. As admitted by the examiner, "Nguyen et al. do not explicitly disclose that the base glass layer contains carbon impurities imbedded in a surface thereof or treating the base glass layer in an oxygen and ozone or hydrogen peroxide plasma to convert the carbon impurities to a gas for removal." See Answer, page 3.

The examiner accordingly relies upon Hochberg, who teaches at column 12 line 62 to column 12, line 1 that "[a] plasma TEOS film deposition, on the other hand, occurs at temperatures below 350° C in the presence of oxygen but does not produce a pure silicon dioxide. The film also contains a significant amount of hydrogen and is also contaminated with organic polymer residues. These carbonaceous impurities are only eliminated in a plasma/ozone process at temperature around 400°C. minimum and in the presence of excess oxygen."

Based upon the teaching in Hochberg the examiner concludes, "that glass films deposited from TEOS and oxygen under plasma conditions at about 350°C is not pure

silicon dioxide and contain carbonaceous impurities and that it is conventional in the art to treat such carbonaceous impurities with an ozone and oxygen plasma to remove those carbonaceous impurities. See Answer, page 3. We disagree with the examiner's analysis and assumptions. The explicit teaching in Hochberg was directed to TEOS film deposition at a temperature below 350° C in the presence of oxygen. In contrast the films of Nguyen are deposited at temperatures between 350° and 450° C in the presence of oxygen, a nitrogen containing gas and helium. See Nguyen, column 4, lines 33-48. Under the conditions disclosed by Nguyen, one cannot necessarily conclude that the first nitrogen containing silicon layer deposited necessarily contains carbonaceous impurities. Moreover, the burden is on the examiner to show that carbon impurities would have been found under the conditions utilized by Nguyen. This burden has not been met. Accordingly, it is not seen why the person having ordinary skill in the art would have treated the first nitrogen containing silicon oxide layer of Nguyen with a plasma ozone process in the presence of excess oxygen as suggested by Hochberg in the background of his invention.

Furthermore, we agree with the appellants' argument that Nguyen 's process does not include hydrogen and organic polymer residues in the silicon layer. See Brief, sentence bridging pages 10 and 11. Accordingly, as the Nguyen plasma film has not been shown to contain, "either hydrogen or organic polymer residue therein, there is no possible

reason for one of ordinary skill in the art to modify the Nguyen et al process to use a plasma TEOS film deposition at temperatures around 400° C." See Brief, page 12.

We conclude that the sole reason for combining the references of record is found in appellant's disclosure. In re Dembiczak, 175 F.3d 994, 999, 50 USPQ2d 1614, 1617 (Fed. Cir. 1999) ("[T]he best defense against the subtle but powerful attraction of a hindsight-based obviousness analysis is rigorous application of the requirement for a showing of the teaching or motivation to combine prior art references.").

DECISION

The rejection of claims 2, 4 through 7, 9, 10 18, 20 through 23, 25 and 26 under 35 U.S.C. § 103(a) as being unpatentable over Nguyen in view of Hochberg is reversed.

The decision of the examiner is reversed.

REVERSED

BRADLEY R. GARRIS Administrative Patent Judge	)
PAUL LIEBERMAN Administrative Patent Judge	) BOARD OF PATENT) APPEALS) AND) INTERFERENCES
PETER F. KRATZ Administrative Patent Judge	)

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